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Which children and young people are excluded from school? Findings from a large British birth cohort study, the Avon Longitudinal Study of Parents and Children (ALSPAC)

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Abstract

Background

Exclusion from school is increasingly recognised as pertinent to child health. National educational data reveal that boys, children who are looked-after, living in poverty, have special educational needs (SEN) or from certain ethnic minorities, are disproportionately excluded from school. As population-based data on the wider characteristics of excluded children are scarce, we aimed to describe predictors of school exclusion in the Avon Longitudinal Study of Parents and Children (ALSPAC).

Method

ALSPAC, a prospective UK population-based birth-cohort study, collected parent reports of permanent school exclusions by 8 years and parent and self-reports of permanent and fixed-term exclusions in the preceding 12 months at 16 years. Potential risk factors were examined for associations with exclusion using logistic regression, with a focus on child mental health and neurodevelopment.

Results

Analyses were based on all available data on 53/8245 (0.6%) pupils excluded from school by 8 years and 390/4482 (8.7%) at 16 years. Key factors associated with exclusion at both time points included male gender, lower socioeconomic status, maternal psychopathology, mental health and behavioural difficulties, psychiatric disorder, social communication difficulties, language difficulties, antisocial activities, bullying/being bullied, lower parental engagement with education, low school engagement, poor relationship with teacher, low educational attainment and SEN (all $p < 0.05$).

Conclusion

Exclusion from school was associated with child, family and school-related factors identifiable at, or prior to, primary school age. Child health professionals have an important role in the holistic, multi-disciplinary assessment of children who are at-risk of exclusion from school. Mental health and neurodevelopmental difficulties should be recognised and supported, to improve the health and educational outcomes amongst this vulnerable group.

Key messages

- 1) Our findings support national guidance that children who are excluded warrant a holistic assessment that goes beyond their educational needs. Child health practitioners have an important role to play in addressing any unrecognised or inadequately supported neurodevelopmental or mental health needs.
- 2) Current policy recognises the need for effective integrated working between health, education and social care for children with complex needs. This study reflects the importance of a collaborative approach to children presenting with disruptive behaviour at school to avoid educational placements breaking down.
- 3) Difficulties experienced by children who are excluded in relation to their mental health, behaviour, social communication and learning may be identifiable early on at primary school or even prior to school entry – providing opportunities for intervention.
- 4) Further research is required to clarify the contribution of mental health and neurodevelopmental disorders to disciplinary exclusion.

Background

Exclusion from school is a disciplinary tool, which is increasingly recognised as pertinent to child health (Parker and Ford 2013). In the short term, exclusion may have significant psychological and practical impacts on the child, their family and others in the school (McDonald and Thomas 2003, Parker *et al.* 2016b, Quin and Hemphill 2014, Smith 2009), whilst in the longer term it is associated with poor mental and physical health, substance abuse, antisocial behaviour, crime, low educational achievement, unemployment and homelessness (Skiba *et al.* 2003, Daniels and Cole 2010, Parsons *et al.* 2001, Berridge *et al.* 2001, Pirrie *et al.* 2011, Hemphill *et al.* 2012, Hemphill *et al.* 2006, Arcia 2006).

The most common reason for exclusion is persistent disruptive behaviour (Parker *et al.* 2016a, DfE 2017), which may be due to unrecognised or inadequately supported needs. Exclusion is unlikely to reduce disruptive behaviour as it fails to address underlying difficulties, and many children experience multiple exclusions (Parsons *et al.* 2001, Bowman-Perrott *et al.* 2013, Theriot *et al.* 2009). Statutory guidance in England suggests that exclusion should trigger a holistic assessment that extends beyond educational needs to identify and remediate contributory factors (DfE. 2012). In practice, it is unclear how often and how effectively such assessments occur.

National educational data reveal that exclusion occurs disproportionately in certain groups; including boys, some ethnic minorities, those eligible for free school meals, and children who are looked-after or have SEN (DfE 2017). National statistics from the USA similarly indicate the disproportionate exclusion of vulnerable children (Krezmien *et al.* 2006, Bowman-Perrott *et al.* 2013). In England, official exclusion rates have increased over the past year (DfE 2017); these data may also hide a wider burden of informal exclusion practices, particularly among children with special educational needs and disability (SEND) (LGO 2011, OCC 2013, Evans 2010, Butler 2011, CAF 2013, AAA 2014, Parker *et al.* 2016b).

Primary research on this issue using population-level data is sparse. Although children with a neurodevelopmental or psychiatric disorder may be more likely to be excluded, two systematic reviews found surprisingly few studies testing this relationship (Parker *et al.* 2014, Whear *et al.* 2014). Research from the US and Australia suggests risk factors may include poor social skills, low academic attainment, emotional and behavioural difficulties, single parenthood, young maternal age, low maternal education, receipt of public assistance, high individual school mobility, poor school 'climate', and low parental expectations, satisfaction and involvement with school (Achilles *et al.* 2007, Bowman-Perrott *et al.* 2013, Bruns *et al.* 2005, Hemphill *et al.* 2014, McElderry and Cheng 2014, Raffaele-Mendez *et al.* 2002, Theriot *et al.* 2009).

The Avon Longitudinal Study of Parents and Children (ALSPAC) is a UK prospective population-based birth-cohort study, which offers an excellent opportunity to examine a range of risk factors for school exclusion. The aim of this study is to describe the broad profiles of children and young people excluded from school.

Methods

Sample

ALSPAC recruited 14,541 pregnant women resident in Avon, South West England, expected to deliver between April 1991 - December 1992. When the oldest children were 7 years old the initial sample was bolstered with eligible cases that failed to join the study originally, so the total sample with child-based data collected after the age of 7 is 15,458 pregnancies, including 14,775 live births and 14,701 children alive at 1 year. The sample and phases of enrolment are described in the cohort profile papers (Boyd *et al.* 2013, Fraser *et al.* 2013), and further information is available on the study website (<http://www.bristol.ac.uk/alspac>), which contains a searchable data dictionary (<http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary>). Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and Local Research Ethics Committees.

Measures

Outcome measure: Exclusion from school

1) Exclusion by eight years:

When the child was eight years seven months old, mothers were asked if their child had ever been excluded from school, creating a binary variable of 'Yes' or 'No'. Those who were not sent or did not complete the questionnaire (n=6826) or respond to the question (n=48) were coded as missing.

2) Exclusion at 16 years:

When the child was approximately 16 years old, mothers and children were asked separately about fixed-term and permanent exclusions from school in the past 12 months. A binary variable was derived; if the mother and/or child had reported any school exclusion this was coded as 'Yes', or if both the mother and child had reported no exclusions, this was coded as 'No'. Questionnaires not sent or completed were coded as missing (n=10,963).

Exposure variables

To determine early discernible differences in children excluded from school, exposure variables focussed on early childhood and included risk factors for disruptive behaviour (Latimer *et al.* 2012) and for exclusion observed in the literature and clinical practice. We split exposures into three groups; Family, Child, and School-related factors. We used all available data rather than restricting investigation to those with complete data on all exposures, therefore each exposure investigated has a different denominator. As a pragmatic approach and because many continuous measures were skewed, distributions were dichotomised to create binary exposures, coded as 1 to indicate risk and 0 to indicate non-risk. Cut-offs were either clinically significant thresholds or used in previous ALSPAC studies. Table 1 provides further details on exposure variables.

Statistical analysis

Logistic regression models explored associations with exposure variables in relation to the two outcome variables; exclusion by 8 years and exclusion at 16 years. Values were not adjusted for multiple testing. Analyses were conducted using Stata v13.1.

Results

Available data

This investigation is based on 8,245 children with data on exclusion by 8 years (56% of the total cohort alive at 1 year) and 4,482 with data on exclusion at 16 years (31% of those alive at 1 year). Children with available data had higher socio-economic status than those without, due to increased attrition of those in lower socio-economic groups (Wolke *et al.* 2009).

Number of children and young people experiencing exclusion

53/8,245 children (0.64%) experienced permanent exclusion by 8 years. At 16 years, Mothers reported 215 children to have been excluded (including 212 with fixed-term exclusions and 11 with permanent exclusions) and 269 children reported exclusion. The total number of cases where exclusion was reported by the mother and/or the child was 390/4,482 (8.7%). Missing data was not the same for both sources, so for the 4,310 participants with data on exclusion from *both* the mother and child at 16 years, we compared reported exclusions between the two; there were 18 cases where the mother reported exclusion whilst the child did not, whilst 106 children reported exclusions that their mothers did not report. Some of these may indicate 'informal' exclusions and question whether appropriate procedures were followed for informing parents every time the pupil was excluded from the educational environment. Of the 53 children excluded by 8 years, only 16 had data on exclusion at 16 years, of whom 9 (56%) had experienced further exclusion; exclusion by 8 years was a strong predictor of exclusion at 16 years (OR 15.27, CI 5.65 - 41.29, $p < 0.001$).

Factors associated with exclusion

Results for family, child and school-related factors are shown in Tables 2, 3 and 4 respectively.

Family

The three family factors most strongly associated with exclusion by 8 years were a history of the mother being suspended from school, rented housing and maternal depression in pregnancy; whilst for exclusion at 16 years they were the mother being suspended, young maternal age, and maternal smoking in pregnancy.

Exclusion at both time points was associated with measures reflecting low socio-economic status, but this association was more consistent for children excluded at 16 years, which may reflect greater statistical power with more reported cases of exclusion. Strikingly, one third of children born to teenage mothers were excluded at the age of 16 years, and almost one third of those with a maternal history of exclusion also experienced exclusion; there was some but only partial overlap between these groups.

Higher levels of adversity in pregnancy and in the first two years of the child's life were associated with exclusion at both time points, whether examined using the Family Adversity Index as a continuous measure, and when dichotomised above the 95th centile (exclusion by 8 years: OR 3.68, CI 1.55 - 8.72, $p = 0.003$, exclusion at 16 years: OR 5.85, CI 3.99 - 8.58, $p < 0.001$).

Child

Psychiatric disorder and social communication difficulties strongly predicted exclusion at both 8 and 16 years. Exclusion by 8 years was also related to worse general health in the pre-school period, and at 16 years, to involvement in antisocial activities.

School

The three school-related factors most strongly associated with exclusion by 8 years were presence of SEN, high levels of school mobility, and poor relationship with the teacher; whilst for exclusion by 16 years they were less parental support for the child's learning, and Key Stage One (KS1) results of \leq level 1 for writing and reading.

Discussion

Our study shows a significant proportion of young people experiencing fixed term or permanent exclusions at 16 years (8.7%). Given this may be an under-estimate, and with the known long-term adverse outcomes of school exclusion, this has widespread potential implications. Furthermore, our findings suggest that exclusion is experienced by children who face multiple vulnerabilities in different areas and stages of life compared to their peers. Excluded children were more likely to have mental health or neurodevelopmental difficulties; however there may be a complex mixture of needs on presentation, and not all may meet clinical/diagnostic thresholds. Exclusion is likely to result from an accumulation of child, family and school factors, which all occur within, and interact with, the wider community and societal context, and amount to a significant burden expressed in the disruptive behaviour that challenges the school. The problem is unlikely to reside solely within the child or family, as is often the perception.

The profile of children excluded at primary and at secondary school age may differ; though we were unable to formally test this hypothesis. Exclusion at primary school was rarer, and may reflect more severe difficulties, whilst in adolescence, difficulties may be more subtle, but numerous and accumulative, particularly in the context of the increasing challenges of a secondary school setting.

Associations with socioeconomic deprivation, family adversity and maternal mental health problems, highlights the importance of considering a child's behaviour in the context of challenges the family may be facing, and the need to focus preventative interventions for families at risk. The association between mothers and children who experience exclusion may highlight genetic contributions, as well as the influence of maternal experiences of education on the child's attitude towards and experience of school.

There was strong evidence for early differences in behaviour amongst excluded children, as well as parental concerns about child health and behaviour in the pre-school period. Professionals should take such concerns seriously, and intervene early. Many child and school-related factors measured early in primary school were still strongly associated with exclusion at 16 years, emphasising that difficulties may be identifiable at an early stage, and early school experiences may have significant influence on later school trajectories.

Relevance to existing literature

The proportion of children excluded from school in our study is higher than currently reported in England and higher than we might expect, given both ALSPAC attrition and school exclusion are socially patterned. However exclusion rates have halved since the late 1990s, so the rates in our study are in line with figures from the time of data collection in 2006/7, but may also reflect informal exclusion episodes missing from national data.

Our results are consistent with known socio-demographic risks for exclusion and findings from US and Australian datasets (Achilles *et al.* 2007, Bowman-Perrott *et al.* 2013, Hemphill *et al.* 2014, Theriot *et al.* 2009) and qualitative work (Daniels *et al.* 2003, Parsons *et al.* 1994, Hayden and Ward 1996, Gordon 2001, Parker *et al.* 2016b) in highlighting the role of family and school factors, in addition to child characteristics. The findings have relevance to children in similar education systems and high-income settings worldwide.

Key implications for policy and practice

The American Academy of Paediatrics has highlighted that school exclusion is an issue that requires more attention from health professionals, particularly paediatricians who can help schools understand and address root causes of disruptive behaviour (AAP 2003). In the UK, the policy response to the seminal report 'Why children die' also called for a much stronger focus on child mental health, especially for children most at risk such as those excluded from school (RCPCH. and NCB. 2014). Our study adds weight to the case that school exclusion is not simply an education issue, but highly relevant for broader child health and wellbeing. UK education/health policy should reflect this, and ensure every school has timely access to psychology/counselling services and links to the local community child health centre.

Our findings support statutory guidance that disruptive behaviour may indicate unmet need and that excluded children warrant a multi-disciplinary assessment that goes beyond their educational situation, with a review of the adequacy of existing support for children with known SEND (DfE. 2012). We recommend such assessments encompass child, family and school-related factors and ideally occur when the *risk* of exclusion is identified, allowing opportunity to intervene and reduce the likelihood of the school placement breaking down. Community paediatricians are well placed to contribute, actively searching for evidence of a neurodevelopmental or mental health condition, and referring to child and adolescent mental health services (CAMHS) and other allied child health professionals as appropriate (Paget and Emond 2016). Child health professionals also have an important role advocating for the rights of children who are illegally excluded, and against disciplinary practices which further disadvantage vulnerable children. Finally, some children may be unable to cope within a mainstream setting, but their move to specialist provision should ideally be planned as the optimal place to meet their needs rather than by default after permanent exclusion.

The need for early identification and intervention for difficulties that could be remediated is clear, given that children most at risk of exclusion are often those already vulnerable to poor outcomes. Early intervention may help redirect children onto a more positive trajectory, and reduce the huge potential costs of educational disengagement, childhood mental health difficulties and social exclusion (Scott *et al.* 2001, Snell *et al.* 2013, Romeo *et al.* 2006); an approach all the more pertinent in an era of financial

austerity. For this to occur, school staff need training in recognising neurodevelopmental and psychiatric disorders, and support in helping such children access the curriculum (Ford *et al.* 2007). Active treatment of behavioural difficulties is important, via prompt and easy access to parenting courses (NICE 2013, Furlong *et al.* 2012), as well as training for school staff on behaviour management.

Strengths and limitations

To our knowledge this is the only exploration of exclusion in a UK birth-cohort, using data from a large population-based study with a wide range of prospectively measured, relevant, robust, and clinically important measures.

This topic is difficult to research as exclusions are relatively rare and occur among ‘hard to reach’ groups, and the use of exclusion varies greatly between schools. Our data were not derived from linked education records, but reported by parents and children. However, this self-reported data is a strength, as it likely includes episodes not officially recorded by the school, thus may be a more realistic estimate of children who experience exclusion.

Our data had no measure of fixed-term exclusions by 8 years and small numbers of permanent exclusions at both time-points. However, permanent exclusions are usually preceded by fixed-term exclusions, suggesting that these children are usually part of the same group. It was not appropriate to statistically compare profiles for exclusions at the two time-points, due to small numbers of exclusions by 8 years and because exclusions were captured in a different way.

Missing data was a limitation. Attrition from ALSPAC was systematic and children who dropped out were more likely to suffer from disruptive behaviour disorder. However, work on the impact of this attrition in ALSPAC (Wolke *et al.* 2009), as well as sensitivity analyses using multiple imputation (Parker 2014), suggests our conclusions would be unlikely to change if complete data were available.

Further research

Further analyses of existing and more recent large cohort studies would help establish more clearly the relationship between exclusion and neurodevelopmental and mental health conditions, as well allowing investigation of the impact of changes in education policy and practice (Parker and Ford 2013). Exploring potentially modifiable risk factors in the school environment would be important, as well as factors associated with positive experiences of school and high levels of attainment among groups predisposed towards exclusion.

Conclusion

Exclusion from school is associated with a multitude of child, family and school-related factors, many of which are present in the pre-school period or early in primary school, allowing opportunity for intervention. Children who are excluded warrant a holistic, multi-disciplinary assessment to identify any unrecognised or inadequately supported difficulties, particularly looking for mental health or neurodevelopmental conditions. School exclusion is not simply an education issue and child health professionals have an important role to play in assessing and supporting children at risk.

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Tables

Table 1: Details of exposure variables investigated

FACTOR	TIME-POINT	SOURCE	SPECIFIC MEASURE AND DESCRIPTION OF VARIABLES CREATED
FAMILY FACTORS			
Parental socioeconomic class	32 weeks gestation	Mother	Occupation was used to calculate social class based on the 1991 Office and Populations Censuses and Surveys standards (OPCS 1991). The highest of maternal and paternal social class was taken: Class I, II Class III, IV, V
Equivalised household income	33 and 47 months	Mother	Dichotomised at lowest 20% of household income
Housing tenure	8 weeks gestation	Mother	Mortgaged/owned Rented
Maternal marital status	8 weeks gestation	Mother	Married Unmarried/divorced/widowed
Maternal education	32 weeks gestation	Mother	Highest maternal educational qualification achieved: A Level/Higher education O level/CSE/Vocational
Mother suspended from school before 17 years	32 weeks gestation	Mother	Not suspended Suspended
Maternal age at delivery	Pregnancy baseline data	Mother	<20 years ≥20 years
Parity	18 weeks gestation	Mother	Primiparous Multiparous
Smoked cigarettes in 1st trimester of pregnancy	18 weeks gestation	Mother	No Yes
Alcohol use in 1 st trimester of pregnancy	18 weeks gestation	Mother	<1 glass/week ≥1 glass/week
Maternal depression in pregnancy	32 weeks gestation	Mother	Edinburgh Post-natal Depression Scale (EPDS) - a cut off of 13 was used to create a binary variable, as it is validated as a good predictor of clinical depression (Murray and Carothers 1990).
Maternal anxiety in pregnancy	32 weeks gestation	Mother	Crown Crisp Experimental Index - a cut off of the top 15% was used as it has been shown to predict emotional and behavioural difficulties in children at 4 years (O'Connor <i>et al.</i> 2002).
Mother life events	8 weeks	Mother	Life events inventory of 42 items occurring since mid-pregnancy, created for ALPSAC using items from

			previous inventories (Brown and Harris 1978, Barnett <i>et al.</i> 1983, Honnor <i>et al.</i> 1994). A binary variable was created using total number of life events, dichotomised at top 25% (≥ 5 life events).
Home environment	6 months	Mother	HOME score – Six-factor measure of the emotional and cognitive home environment, adapted from the HOME observation inventory for ALSPAC (Caldwell and Bradley 1979). A dichotomous variable was created with suboptimum HOME environment defined as the lowest 25% of the total score.
Mother's parenting	6 months	Mother	Mother's parenting score – seven-factor measure of cognitive stimulation, adapted from the HOME observation inventory for ALSPAC (Caldwell and Bradley 1979). A dichotomous variable was created with suboptimum parenting defined as the lowest 25% of the total score.
Maternal psychopathology	2 years	Mother	A summary item from the Family Adversity Index (Steer <i>et al.</i> 2004) designating whether the mother had any depression, anxiety or suicide attempts during the 1st 2 years of the child's life: No Yes
Family Adversity	Pregnancy	Mother	The Family Adversity Index (FAI) (Steer <i>et al.</i> 2004) was developed by the ALSPAC team to create an index of multiple family risks. It included 18 items taken from questionnaires administered throughout pregnancy (8, 12, 18 and 32 weeks gestation), including risk factors related to the age of mother, housing, education, finance, partner relationships, family, social network, maternal mental health, substance abuse, and crime. For each item of adversity that was present a score of 1 was given, and a total FAI score was gained by summing all 18 items, the higher score indicated more adversity. A binary variable was created with scores ≥ 5 indicating high family adversity (dichotomised at 95th centile) (Macleod <i>et al.</i> 2008).
Family Adversity	Birth-2years	Mother	Family Adversity Index (FAI) as above. A binary variable was created with scores ≥ 6 indicating high family adversity (dichotomised at 95th centile as per (Macleod <i>et al.</i> 2008))
CHILD FACTORS			
Sex	Child baseline data	Mother	Female Male
Child ethnic background	32 weeks gestation	Mother	White Black or Minority Ethnic
Preterm birth	Child baseline data	Mother, Obstetric records	No (Gestation ≥ 37 weeks) Yes (Gestation < 37 weeks)
Low birth-weight	Child baseline data	Mother, Obstetric records	No (Birth-weight ≥ 2500 g) Yes (Birth-weight < 2500 g)
Development	1 year 6 months	Mother	An estimate of the child's developmental abilities used a scale developed by ALSPAC, including items from the Denver Developmental Screening Test. A set of questions completed by the mother was used to calculate a continuous total score including the four developmental domains (gross motor, fine

			motor, communication, and social skills). A dichotomous variable was created with suboptimum development defined as the lowest 10% of the total development score ((Chittleborough <i>et al.</i> 2011).
Mother concerned about child's behaviour	2 years 8 months	Mother	Mothers were asked if they were worried about their child's behaviour development: No Yes
Language development	3 years 2 months	Mother	Modified version of the MacArthur Communication Questionnaire (Fenson <i>et al.</i> 1994) used to create a total language score, incorporating measures of vocabulary, tenses, plurals and word combinations. The score was dichotomised at the lowest 10% to reflect children with poor language development.
Child general health	3 years 6 months	Mother	Mothers were asked about their child's general health over the past year, with responses collapsed into a dichotomous variable: Very healthy/mostly well Sometimes ill/never well
Mental health problems	3 years 6 months	Mother	Childhood mental health problems were assessed using the Strengths & Difficulties Questionnaire (SDQ). The total difficulties score (combination of four sub-scales: hyperactivity, emotional symptoms, conduct problems, peer problems) was dichotomised at the recommended clinical cut off (≥ 14) (Goodman 1997).
Psychiatric disorder	7 years	Mother Teacher	The Development and Well-Being Assessment (DAWBA) (Goodman <i>et al.</i> 2000) composed of questions relating to a number of common emotional and behavioural disorders in children occurring in the present and recent past. A dichotomous summary variable was used to indicate any psychiatric disorder generated by the DAWBA, as well as variables indicating clinical diagnoses of any ADHD disorder, any oppositional defiant/conduct/behavioural disorder, any pervasive developmental disorder, and any emotional disorder (anxiety/depressive disorder).
Social Communication difficulties	7 years 7 months	Mother	12-item Social Communication Disorder Checklist (SCDC; score range 0–24) (Skuse <i>et al.</i> 2005). The SCDC is a brief screening instrument of social reciprocity and verbal/nonverbal communication with high sensitivity and specificity for autism (Bölte <i>et al.</i> 2011) with higher scores reflecting more social-communication deficits. The SCDC was dichotomised at the clinical cut off (SCDC<9 vs SCDC \geq 9), which has been previously shown to provide maximum discrimination between all PDD diagnoses and normal comparisons (Skuse <i>et al.</i> 2005).
Antisocial activities	8 years	Child in Clinic	11 items from the Self-Reported Antisocial Behavior for Young Children Questionnaire (Loeber <i>et al.</i> 1989). The total number of antisocial activities was dichotomised to indicate involvement in ≥ 1 antisocial activity.

Bullying	8 years	Child in Clinic	A modified version of the Bullying and Friendship Interview Schedule (BFIS) (Wolke <i>et al.</i> 2000), indicating whether or not the child had been a victim or perpetrator of overt (e.g. name-calling, physical aggression) or relational bullying (e.g. withdrawing friendship, spreading rumours). Children are categorised into Neutral, Bully, Victim, or Bully-victim, with dichotomous variables constructed to indicate any involvement in bullying: Neutral Bully/victim/bully-victim
IQ	8 years	Child in Clinic	Wechsler Intelligence Scale for Children (WISC- III UK) (Wechsler 1992). Total IQ was categorised into low (<90), average (90-109) and high (110-151) based on the WISC-IV/WASI-IV classification. A dichotomous variable indicating presence of low IQ was created.
Language	8 years	Child in clinic	20 minute direct assessment of children's language functioning was assessed on the Weschler Objective Language Dimensions (WOLD) (Rust 1996) verbal comprehension task, and short-term phonological memory and processing abilities were assessed using an adaptation of the Children's Test of Non-word Repetition (NWR, CNRep) (Gathercole and Baddeley 1996). Both scores were dichotomised at lowest 10% to indicate children with language difficulties.
SCHOOL-RELATED FACTORS			
Key Stage 1 results	7 years 4 months	National Pupil Database	Data on the child's Key Stage 1 (KS1) assessments was obtained through data linkage with the Local Education Authority. Dichotomous variables were created indicating whether the child had failed to achieve expected levels (\geq Level 2) for the Reading , Writing and Mathematics KS1 tests.
School engagement	7 years 7 months	Mother	Derived score built from responses to two Likert scale questions on whether the child is stimulated by school and whether they are bored in school (Gutman and Vorhaus 2012), with a higher score indicating higher school engagement. Dichotomised at approximately lowest 10% to indicate those with low school engagement (score 0-3= 1 and score 4-6=0).
School enjoyment	7 years 7 months	Mother	Derived score built from responses to two Likert scale questions on whether the child enjoys school and whether they look forward to going to school (Gutman and Vorhaus 2012), with a higher score indicating higher school enjoyment. Dichotomised at approximately lowest 10% to indicate those with low school enjoyment (score 0-3= 1 and score 4-6=0).
Relationship with teacher	7 years 7 months	Mother	Likert score question indicating whether the child likes their teacher, collapsed into a binary variable: Usually/always likes teacher Not at all/only sometimes likes teacher
Parental interest/ involvement in education	7-8 years	Teacher	Likert score question indicating how supportive parents are towards their child's learning, collapsed into a binary variable: Very supportive Somewhat/Not at all supportive/difficult to say

Special Educational Needs (SEN) status	7-8 years	Mother, Teacher	Responses to questions about the child's SEN statement status were combined into a dichotomous variable: Never been considered for a statement of SEN Has a SEN statement or has been considered for a statement
School mobility	8 years	Mother	Number of schools since 5 th birthday: 1-2 3+

Table 2: Family factors and exclusion from school

EXPOSURE	EXCLUSION BY 8 YEARS					EXCLUSION AT 16 YEARS				
	N with data (8245)	No (8192) N (%)	Yes (53) N (%)	OR (95% CI)	p value	N with data (4482)	No (4092) N (%)	Yes (390) N (%)	OR (95% CI)	p value
Lower parental socioeconomic status (Class III, IV, V)	7312	2914/7269 (40.1)	20/43 (46.5)	1.30 (0.71 - 2.37)	0.393	4066	1267/3741 (33.9)	151/325 (46.5)	1.69 (1.35 - 2.13)	<0.001
Low household income (bottom 20%)	7162	1166/7120 (16.4)	13/42 (31.0)	2.29 (1.19 - 4.42)	0.014	3956	449/3638 (12.3)	75/318 (23.6)	2.19 (1.66 - 2.89)	<0.001
Rented housing tenure	7691	1351/7643 (17.7)	18/48 (37.5)	2.79 (1.55 - 5.03)	0.001	4201	481/3854 (12.5)	108/347 (31.1)	3.17 (2.48 - 4.05)	<0.001
Unmarried mother	7743	1082/7697 (14.1)	9/46 (19.6)	1.49 (0.72 - 3.09)	0.288	4233	447/3883 (11.5)	85/350 (24.3)	2.47 (1.89 - 3.21)	<0.001
Lower maternal educational status (O level/CSE/Vocational)	7671	4459/7624 (58.5)	34/47 (72.3)	1.86 (0.98 - 3.52)	0.058	4220	1935/3869 (50.0)	256/351 (72.9)	2.69 (2.11 - 3.44)	<0.001
Mother suspended from school	7640	167/7593 (2.2)	5/47 (10.6)	5.29 (2.07 - 3.55)	0.001	4203	56/3862 (1.5)	24/351 (6.8)	4.98 (3.04 - 8.13)	<0.001
Maternal age ≤20 years at delivery	7910	173/7861 (2.2)	2/49 (4.1)	1.89 (0.46 - 7.85)	0.380	4302	41/3934 (1.0)	20/368 (5.4)	5.46 (3.16 - 9.42)	<0.001
Multiparous	6528	4186/6494 (64.5)	21/34 (61.8)	0.89 (0.45 - 1.78)	0.743	3878	2178/3578 (60.9)	216/300 (72.0)	1.65 (1.27 - 2.15)	<0.001
Smoking in 1 st trimester pregnancy	7771	1491/7725 (19.3)	12/46 (26.1)	1.48 (0.76 - 2.86)	0.248	4248	547/3891 (14.1)	123/357 (34.5)	3.21 (2.54 - 4.07)	<0.001
Alcohol in 1 st trimester pregnancy (≥1 glass/wk)	7729	1187/7684 (15.5)	6/45 (13.3)	0.84 (0.36 - 1.99)	0.696	4227	590/3872 (15.2)	62/355 (17.5)	1.18 (0.88 - 1.57)	0.267
Maternal depression in pregnancy (EPDS score≥13)	7456	977/7411 (13.2)	13/45 (28.9)	2.67 (1.40 - 5.12)	0.003	4109	391/3764 (10.4)	56/345 (16.2)	1.67 (1.23 - 2.27)	0.001
Maternal anxiety in pregnancy (CCEI ≥85 th Centile)	7277	1120/7234 (15.5)	11/43 (25.6)	1.88 (0.94 - 3.73)	0.073	4019	460/3685 (12.5)	62/334 (18.6)	1.60 (1.19 - 2.14)	0.002
Stressful life events in perinatal period (≥5)	7550	2144/7505 (28.6)	23/45 (51.1)	2.61 (1.45 - 4.70)	0.001	4159	1019/3820 (26.7)	123/339 (36.3)	1.57 (1.24 - 1.98)	<0.001
Low home environment score at 6 months (bottom 25%)	7532	1730/7490 (23.1)	12/42 (28.6)	1.33 (0.68 - 2.61)	0.403	4162	809/3826 (21.2)	86/337 (25.5)	1.28 (0.99 - 1.65)	0.062
Low maternal parenting score at 6 months (bottom 25%)	7522	1575/7480 (21.1)	6/42 (14.3)	0.62 (0.26 - 1.49)	0.287	4158	723/3821 (18.9)	74/337 (22.0)	1.21 (0.92 - 1.58)	0.175
Any maternal psychopathology	7804	1557/7755	17/49	2.11 (1.17 - 3.82)	0.013	4251	699/3896	86/355	1.46 (1.13 - 1.88)	0.004

during 1st 2 years		(20.1)	(34.7)				(18.0)	(24.2)		
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Table 3: Child factors and exclusion from school

EXPOSURE	EXCLUSION BY 8 YEARS					EXCLUSION AT 16 YEARS				
	N with data (8245)	No (8192) N (%)	Yes (53) N (%)	OR (95% CI)	p value	N with data (4482)	No (4092) N (%)	Yes (390) N (%)	OR (95% CI)	p value
Male sex	8245	4159/8192 (50.8)	40/53 (75.5)	2.98 (1.59 - 5.59)	0.001	4482	1767/4092 (43.2)	246/390 (63.1)	2.25 (1.81 - 2.79)	<0.001
Non-white ethnic background	7539	277/7494 (3.7)	2/45 (4.4)	1.21 (0.29 - 5.03)	0.791	4167	118/3821 (3.1)	18/346 (5.2)	1.73 (1.04 - 2.88)	0.034
Preterm birth (<37 weeks)	7909	422/7860 (5.4)	2/49 (4.1)	0.75 (0.18 - 3.10)	0.691	4302	203/3934 (5.2)	13/368 (3.5)	0.67 (0.38 - 1.19)	0.174
Low Birth-Weight (≤2500g)	7812	342/7765 (4.4)	1/47 (2.1)	0.47 (0.06 - 3.43)	0.458	4245	181/3882 (4.7)	12/363 (3.3)	0.70 (0.39 - 1.27)	0.238
Poor development at 18 months (bottom 10%)	7493	741/7449 (10.0)	8/44 (18.2)	2.01 (0.93 - 4.34)	0.075	4150	404/3803 (10.6)	39/347 (11.2)	1.07 (0.75 - 1.51)	0.722
Mother concerned about child's behaviour at 2 yrs 6 months	7326	428/7282 (5.9)	5/44 (11.4)	2.05 (0.81 - 5.24)	0.132	4057	197/3733 (5.3)	31/324 (9.6)	1.90 (1.28 - 2.82)	0.002
Poor language development at 3 yrs 2 months (bottom 10%)	7121	669/7081 (9.5)	9/40 (22.5)	2.78 (1.32 - 5.87)	0.007	3971	285/3655 (7.8)	38/316 (12.0)	1.62 (1.13 - 2.32)	0.009
Worse general health at 3 yrs 6 months	7268	262/7226 (3.6)	6/42 (14.3)	4.43 (1.85-10.61)	0.001	4037	116/3716 (3.1)	16/321 (5.0)	1.63 (0.95 - 2.78)	0.075
Mental health problems at 3 yrs 6 months (SDQ total difficulties≥14)	7133	1026/7090 (14.5)	17/43 (39.5)	3.86 (2.09 - 7.15)	<0.001	3969	433/3645 (11.9)	67/324 (20.7)	1.93 (1.45 - 2.58)	<0.001
Any psychiatric disorder at 7 yrs	7462	386/7417 (5.2)	17/45 (37.8)	11.06 (6.00 - 20.38)	<0.001	4119	152/3785 (4.0)	47/334 (14.1)	3.91 (2.76 - 5.55)	<0.001
ADHD	7080	134/7038 (1.9)	8/42 (19.1)	12.12 (5.51 - 26.68)	<0.001	3964	47/3662 (1.3)	18/302 (6.0)	4.87 (2.79 - 8.50)	<0.001
PDD	7080	25/7038 (0.4)	1/42 (2.4)	6.84 (0.91 - 51.69)	0.062	3964	11/3662 (0.3)	1/302 (0.3)	1.10 (0.14 - 8.57)	0.926
ODD/CD	7080	196/7038 (2.8)	13/42 (31.0)	15.65 (8.01 - 30.56)	<0.001	3964	53/3662 (1.5)	32/302 (10.6)	8.07 (5.12 - 12.73)	<0.001
Emotional disorder	7080	221/7038 (3.1)	5/42 (11.9)	4.17 (1.62 - 10.7)	0.003	3964	98/3662 (2.7)	13/302 (4.3)	1.64 (0.91 - 2.95)	0.103
Social communication difficulties	6990	506/6949	15/41	7.35 (3.87 - 3.96)	<0.001	3927	209/3631	42/296	2.71 (1.90 - 3.86)	<0.001

at 7 yrs 7 months (SCDC≥9)		(7.3)	(36.6)				(5.8)	(14.2)		
Antisocial activities at 8 yrs (≥1 activity)	6079	1326/6044 (21.9)	15/35 (42.9)	2.67 (1.36 - 5.23)	0.004	3591	615/3310 (18.6)	107/281 (38.1)	2.69 (2.09 - 3.48)	<0.001
Any involvement in overt bullying at 8 yrs (bully/victim/bully-victim)	6042	2069/6010 (34.4)	19/32 (59.4)	2.78 (1.37 - 5.65)	0.005	3587	1060/3307 (32.1)	126/280 (45.0)	1.73 (1.36 - 2.22)	<0.001
Low IQ at 8 yrs (Total IQ<90)	6358	1196/6321 (18.9)	12/37 (32.4)	2.06 (1.03 - 4.11)	0.041	3745	491/3451 (14.2)	75/294 (25.5)	2.06 (1.56 - 2.73)	<0.001

Table 4: School-related factors and exclusion from school

EXPOSURE	EXCLUSION BY 8 YEARS					EXCLUSION AT 16 YEARS				
	N with data (8245)	No (8192) N (%)	Yes (53) N (%)	OR (95% CI)	p value	N with data (4482)	No (4092) N (%)	Yes (n=390) N (%)	OR (95% CI)	p value
Below expected level at Key Stage 1 ≤Level 1 in Reading	6549	670/6503 (10.3)	9/46 (19.6)	2.12 (1.02 - 4.41)	0.045	3484	183/3152 (5.8)	43/332 (13.0)	2.41 (1.70 - 3.44)	<0.001
≤Level 1 in Writing	6547	684/6501 (10.5)	12/46 (26.1)	3.00 (1.55 - 5.82)	0.001	3484	196/3152 (6.2)	52/332 (15.7)	2.80 (2.01 - 3.89)	<0.001
≤Level 1 in Maths	6542	468/6496 (7.2)	6/46 (13.0)	1.93 (0.81 - 4.58)	0.135	3481	147/3149 (4.7)	21/332 (6.3)	1.38 (0.86 - 2.22)	0.177
Low school engagement score at 7 yrs 7 months (bottom 10%)	6994	663/6953 (9.5)	9/41 (22.0)	2.67 (1.27 - 5.61)	0.010	3929	299/3632 (8.2)	49/297 (16.5)	2.20 (1.59 - 3.06)	<0.001
Low school enjoyment score at 7 yrs 7 months (bottom 10%)	7032	829/6991 (11.9)	7/41 (17.1)	1.53 (0.68 - 3.46)	0.307	3941	390/3643 (10.7)	53/298 (17.8)	1.80 (1.32 - 2.47)	<0.001
Child never/sometimes likes their teacher at 7 yrs 7 months	7028	501/6988 (7.2)	9/40 (22.5)	3.76 (1.78 - 7.94)	0.001	3943	201/3646 (5.5)	26/297 (8.8)	1.64 (1.07 - 2.52)	0.022
Parents are somewhat/not at all supportive of child's learning at 7-8 yrs	3868	1413/3844 (36.8)	16/24 (66.7)	3.44 (1.47 - 8.06)	0.004	2121	563/1945 (29.0)	94/176 (53.4)	2.81 (2.06 - 3.84)	<0.001
SEN status at 7-8 yrs (SEN statement in place/considered)	3482	344/3454 (10.0)	18/28 (64.3)	16.27 (7.45 - 35.54)	<0.001	1963	124/1813 (6.8)	21/150 (14.0)	2.22 (1.35 - 3.64)	0.002
School mobility at 8 yrs (≥3 schools)	8098	331/8049 (4.1)	7/49 (14.3)	3.89 (1.73 - 8.72)	0.001	4022	150/3708 (4.1)	11/314 (3.5)	0.86 (0.46 - 1.61)	0.638

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